R&D Progress of the Divertor Material/Component

Testing Facilities of CRAFT


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ABSTRACT

- Conceptual design and machine design phases of a large linear plasma facility and a high heat flux (HHF) test device have been finished.
- A prototype linear plasma machine employing conventional water-cooled magnets has been constructed which can maintain a steady-state magnetic field strength of ~0.8 T and test various new high-density plasma sources with particle flux up to 10^{23}-10^{24} m^{-2}s^{-1}.
- A pilot HHF device has been built for qualifying new EAST PFCs and testing relevant HHF instrumentation.

BACKGROUND

- To support the R&D of China Fusion Engineering Test Reactor (CFETR) [1], a Comprehensive Research Facility for Fusion Technology (CRAFT) program has been launched at the Institute of Plasma Physics, Chinese Academy of Sciences (ASIPP).
- Within the CRAFT program, a divertor material/component testing project is authorized to address some key R&D issues of plasma-facing materials and components for CFETR in appropriate physical regimes, size and time scales of plasma-material interactions.
- This project includes two user-facilities: a large linear plasma machine and a high heat flux (HHF) test device. The project started from September 2019 and is scheduled to be completed in 2024.

MACHINE PARAMETERS

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<tr>
<th>Large linear plasma testing facility (Fig. 1(a))</th>
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<td>The baseline plasma diagnostics include Thomson scattering, emission spectrum and target probes.</td>
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<td>In-situ tools for material analysis like laser-induced breakdown spectroscopy (LIBS), ion beam analysis (IBA) and thermal desorption spectroscopy (TDS) will be installed.</td>
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<th>High heat flux test facility (Fig. 1(b))</th>
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<td>It is equipped with two electron beam guns (60 kW@120 kV and 800 kW@60 kV) and the maximum scanning area is ~1 m².</td>
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<td>This HHF facility will be connected to high temperature high pressure water and helium loops.</td>
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Table 1. Machine parameters

| Shot length | >1000 s |
| Particle flux | >1x10^{27} m^{-2}s^{-1} |
| Magnetic field | >3 T |

R&D PROGRESS

Prototype linear plasma machine

- A source testing platform (Fig. 3(a)) is developed at ASIPP. As a compact machine for source testing purpose, this linear plasma device is able to maintain relatively high steady-state magnetic field strength (0.8 T) with cost-effective copper magnets.
- Realtime ion flux measurement is available by utilizing a water-cooled target probe.
- With a relatively low fluid conductance (small vacuum chamber), high flux (~0.5x10^{24} m^{-2}s^{-1}) steady-state experiments are performed successfully.

Pilot high heat flux test facility

- A HHF device (Fig. 3(b)) equipped with a 100-kW electron gun is built to qualify new EAST PFCs [2] and to test relevant HHF instrumentation.

CONCLUSION

- The design work of the large linear plasma machine and the HHF test device of CRAFT project has been finished.
- A prototype linear plasma machine and a pilot HHF test facility are successfully commissioned.
- The facilities will provide new research opportunities for users in the whole PMI research community.

ACKNOWLEDGEMENTS / REFERENCES